Report Date: 30 Jun 2014

Summary Report for Individual Task
551-88L-3064
Troubleshoot a Generator
Status: Approved

Condition: Given a generator aboard a vessel, at sea, at anchor or moored alongside a pier, day or night, under all sea and weather conditions, while wearing appropriate PPE, (i.e. hearing protection, Nitrile gloves, eye protection, etc.), lock out tag out kit and a marine rail tool box.

Standard: The Soldier correctly troubleshoots a generator aboard an Army vessel, IAW the appropriate Technical Manual and local SOPs, without injury to self or others and without damage to equipment.

Special Condition: None

Safety Risk: Medium

MOPP 4:

Task Statements

Cue: None

DANGER

None

WARNING

None

CAUTION

None

Remarks: None

Notes: None

Performance Steps

1. Demonstrate basic troubleshooting procedures for a generator.

a. Identify the components of a generator as shown in Figure 551-88L-3064_01. This figure shows views of each side of the generator set with locations of major components indicated. The reference number key and the description of these components follow below.

(1) Instrument Panel (1). An electrical panel on top of the engine that contains the local display of operational gauges and the switches for local control of the engine.

(2) Air Cleaner Assembly (2). The filter canister and cover assembly, located on the top, front end of the engine.

(3) Aftercooler (Intake Manifold) (3). The intake air cooling and distribution tank, and piping (assembly), on the right side of the engine.

(4) Rotary Sump Pump (4). The manually operated oil pump, located on the front, right side of the engine.

(5) Generator Assembly (5). The electric power producing assembly, connected to the flywheel housing on the front of the engine.

(6) Flywheel Housing (6). The housing, located between the engine and the generator assembly containing the engine flywheel.

(7) Fuel Filters (7). Applies only to vessels without MWO 55-1905-223-55-7 installed. Two spin-on type filters, located together on the lower right side of the engine.

(8) Lube Oil Pump (8). A gear driven pump, located on the right, rear corner of the engine.

(9) Fuel Pump (9). A PT (type G) pump and throttle assembly with a 24-volt shutoff valve and electric governor actuator located on the right, rear end of the engine.

(10) Water Filter (10). A spin-on filter containing diesel coolant additive (DCA), located on the left side near the rear end of the engine.

(11) Fresh Water Pump (11). The belt driven pump, located on rear end of the engine.

(12) Fuel Filter/Water Separator (12). Applies only to vessels with MWO 55-1905-223-55-7 installed. Two fuel filter/water separators, located on the front of the engine.

(13) Lube Oil Filter/Cooler (13). The spin-on filter and cooling core assembly, located on the left sidenear the rear-of the engine.

(14) Coolant Heater (14). The engine jacket water heater, located at the bottom of the engine on the left side. It is mounted to the subbase frame.

(15) Starter (15). The electrical (starboard engine) or air (port engine) controlled starter motor, located on the left, front corner of the engine.

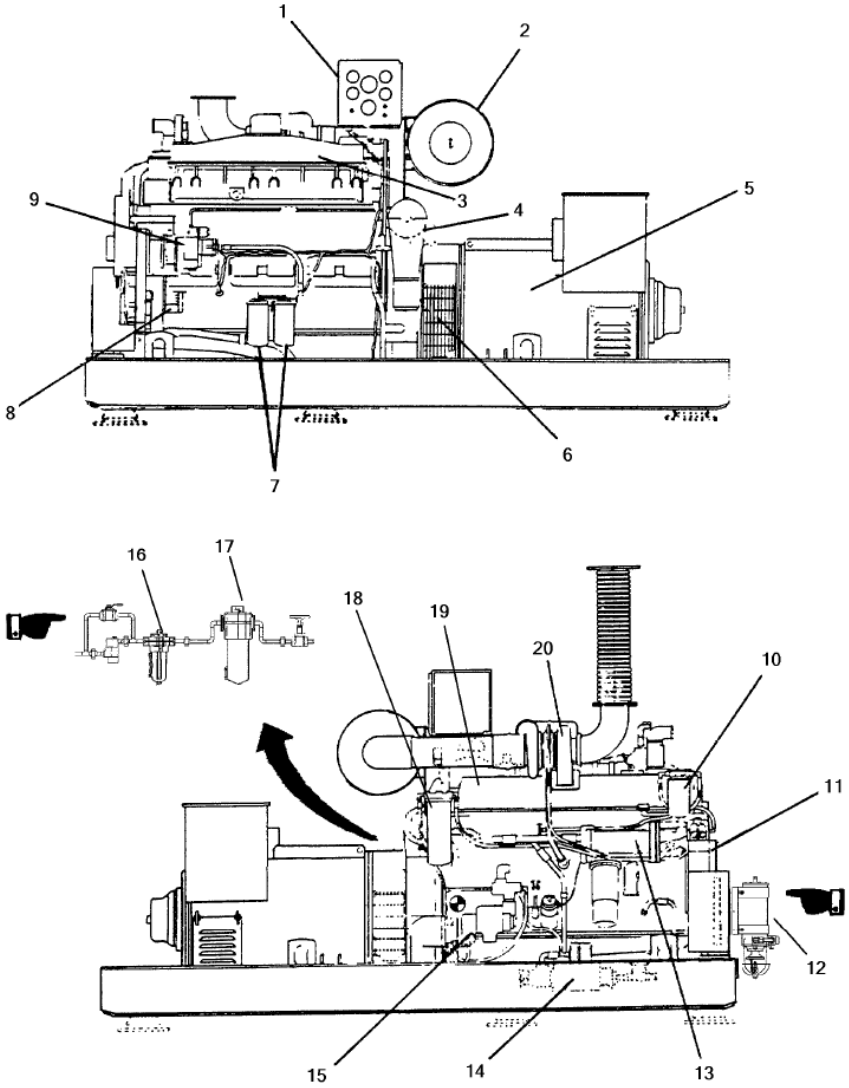
(16) Lubricator (16). Provides atomized lubricant to compressed air for air start system, located on the left side of the engine (port engine).

(17) Coalescer Filter (17). Filters compressed air for air start system, located on the left side of the engine (port engine).

(18) Bypass Oil Filter (18). A spin-on filter, located on the left, front corner near the top of the engine.

(19) Exhaust Manifold (19). The water cooled exhaust air assembly, on the left side of the engine. The turbocharger is mounted on this manifold.

(20) Turbocharger (20). A turbine wheel unit, mounted on the exhaust manifold on the left side of the engine.



Location of Major Components
Figure_551-88L-3064_01

b. General Engine Noise Diagnostic Procedures.

(1) When diagnosing engine noise problems, make sure that noises caused by accessories, such as the air compressor and power takeoff, are not mistaken for engine noises.

(2) Remove the accessory drive belts to eliminate noise caused by these units. Noise will also travel to other metal parts not involved in the problem.

(3) The use of a stethoscope can help locate an engine noise.

c. Frequency of Engine Noise.

(1) Engine noises heard at the crankshaft speed (engine rpm) are noises related to the crankshaft, rods, pistons, and piston pins.

(2) Noises heard at the camshaft speed (one-half of the engine rpm) are related to the valve train.

(3) A hand-held digital tachometer can help to determine if the noise is related to components operating at the crankshaft or camshaft speed.

d. Isolating Engine Noise.

(1) Engine noise can sometimes be isolated by holding down the injector plungers one at a time.

(2) If the volume of the noise decreases or the noise disappears, it is related to that particular engine cylinder.

e. Accessory Noise.

(1) Engine driven components and accessories, such as gear-driven fan clutches, hydraulic pumps, belt-driven alternators, and turbochargers can contribute to engine noise.

(2) Isolate each components when using troubleshooting procedures.

f. Main Bearing Noise.

(1) The noise caused by a loose main bearing is a loud, dull knock heard when the engine is pulling a load.

(2) If all main bearings are loose, a loud clatter will be heard; The knock is heard regularly every other revolution.

(3) The noise is the loudest when the engine is "lugging" or under heavy load.

(4) The knock is duller than a connecting rod noise.

(5) Low oil pressure can also accompany this condition.

(6) If the bearing is not loose enough to produce a knock by itself, the bearing can knock if the oil is too thin or if there is no oil at the bearing.

(a) An irregular noise can indicate worn crankshaft thrust bearings.

(b) An intermittent sharp knock indicates excessive crankshaft end clearance. Repeated clutch disengagements can cause a change in the noise.

g. Connecting Rod Bearing Noise.

(1) Connecting rods with excessive clearance knock at all engine speeds and under both idle and load conditions.

(2) When the bearings begin to come loose, the noise can be confused with piston slap or loose piston pins.

(3) The noise increases in volume with engine speed.

(4) Low oil pressure can also accompany this condition.

h. Piston Noise.

(1) It is difficult to tell the difference between piston pin, connecting rod, and piston noise.

(2) A loose piston pin causes a loud double knock which is usually heard when the engine is idling.

(3) When the injector to this cylinder is held down, a noticeable change will be heard in the sound of the knocking noise.

(4) On some engines, the knock becomes more noticeable when the engine is operated at a steady speed.

i. White Smoke.

(1) White smoke is the result of incomplete combustion and is generally associated with engine startup at low ambient temperatures.

(2) This condition is more predominant on high horsepower fixed injection timing engines because the fuel and combustion systems are optimized for maximum performance and for reliability and durability under high load operating conditions.

2. Conduct basic troubleshooting procedures for a generator.

a. Loss of engine coolant (external leakage).

(1) Check if pressure cap on remote expansion tank is incorrect or malfunctioning.

(2) Check all hose clamps for security.

(3) Check all hoses for leaks.

(4) Check if coolant expansion plugs, pipe plugs, or fitting are leaking.

(a) Inspect coolant plugs and fittings.

(b) Tighten or replace if necessary.

(5) Check if gaskets are leaking or installed incorrectly.

(6) Check if lubricating oil cooler/filter is leaking.

(a) Inspect lubricating oil cooler

(b) Replace oil cooler/filter.

(7) Check if water pump seal is leaking; replace the water pump.

(8) Check if aftercooler is leaking as follows:

(a) Disconnect the coolant supply and the return hoses from the aftercooler.

(b) Plug the hoses after removing them from the aftercooler.

Note: The engine must be operated at rated speed and full load to detect air in the cooling system due to a defective aftercooler core.

(c) Repeat the test for air in the cooling system as previously described; If no air is found in the cooling system with the aftercooler isolated, install a new aftercooler

(9) Check for leaking coolant draincocks; check, tighten or replace if necessary.

b. Loss of engine coolant (internal leakage).

(1) Check for leaking cylinder head or gasket.

(2) Check if lubricating oil cooler is leaking.

(3) Check if aftercooler is leaking.

(4) Check for leaking cylinder head, gasket, liner or block.

(5) Check for combustion gases in cooling system.

(6) Check for incorrectly seated injector sleeves.

c. Low lubricating oil pressure.

(1) Check if oil level is incorrect.

(2) Check if oil pressure gauge is malfunctioning.

(3) Check for oil diluted with fuel.

(4) Check for incorrect oil specifications.

(5) Check if oil temperature is above normal 250° F (120° C).

d. High lubricating oil pressure.

(1) Check if oil pressure gauge is malfunctioning.

(2) Check for incorrect oil specifications.

(3) Check for defective oil filter/cooler; replace oil filter/cooler.

e. Lubricating oil temperature above normal.

(1) Check for incorrect oil level.

(2) Check for high engine coolant temperature (above 212°F) (100°C).

(3) Check if oil temperature gauge is malfunctioning.

(4) Check for malfunctioning oil cooler bypass valve.

f. Excessive lubricating oil consumption.

(1) Check for external oil leaks.

(2) Check if blowby restriction is causing external oil leaks.

(3) Check for incorrect oil specifications.

(4) Check if oil is contaminated with fuel.

(5) Check for high oil temperature (above 250°F) (120°C).

(6) Check if turbocharger seal is malfunctioning; replace turbocharger.

g. Turbocharger noise.

(1) Check for incorrect turbocharger installed.

(2) Check for intake or exhaust air leaks.

(3) Check for excessive intake air restriction.

(4) Check for excessive exhaust restriction.

(5) Check for defective turbocharger compressor impeller or turbine wheel.

(6) Check for turbocharger bearings damage.

(7) Replace turbocharger if necessary.

h. Low power or excessive smoke (low turbocharger boost pressure).

(1) Check for engine overload; reduce engine load.

(2) Check for incorrect turbocharger installed.

(3) Check for dirty air filter element.

(4) Check for intake or exhaust air leaks.

(5) Check for excessive exhaust restriction.

(6) Check for intake air restriction.

(7) Check for defective turbocharger bearings; replace if necessary.

(8) Check for malfunction in fuel system.

3. Conduct troubleshooting procedure for coolant temperature above normal.

WARNING

Make sure engine is cooled to below 120°F (50°C) to avoid burn injury.

a. Check if coolant level is low; add coolant as required.

b. Check function of shutoff valves on either side of the water filter; make sure they are completely open, counterclockwise.

c. Check for collapsed or restricted hoses; replace hoses as needed.

d. Check if water pump belt is loose; check belt tension and tighten if necessary.

e. Check if oil level is incorrect; add or drain engine oil.

f. Check if pressure cap on remove expansion tank is incorrect or malfunctioning.

g. Check if temperature gauge is malfunctioning.

(1) Check for a blown fuse.

(2) Check the wiring from the gauge to the sending unit for a broken connection.

(3) Check the temperature sending unit in the front upper water manifold.

(4) Use a temperature gauge of known accuracy to check system.

(5) Replace faulty gauge.

h. Check for combustion gases in the cooling system.

(1) Remove pressure cap located on the remote mounted expansion tank.

(2) Install a pressure cap which has had the spring and relief valve removed to allow free flow from the overflow tube.

(3) Attach a hose to the overflow connection.

(4) Put the hose end into a container of water.

(5) Operate the engine until water temperature reaches 180°F (80°C).

(6) Check for bubbles coming from the end of the hose submerged in water.

(7) A continuous flow of air bubbles indicates the following:

(a) After cooler core leaks.

(b) Cylinder liner protrusion incorrect.

(c) Cracked cylinder liner.

(d) Cylinder head or gasket leakage.

(8) If no bubbles are present, do the following:

(a) Remove the test equipment.

(b) Check coolant level and fill if necessary.

(c) Install the expansion tank pressure cap.

(d) Operate the engine until it reaches a temperature of 180°F (80°C) and check for coolant leaks.

i. Check for overconcentration of antifreeze and/or supplemental coolant additives.

j. Check if thermostat is incorrect or malfunctioning.

(1) Remove the upper radiator hose from the thermostat housing.

(2) Install a hose of the same size on the thermostat housing outlet long enough to reach a remote dry container used to collect coolant.

(3) Install and tighten a hose clamp on the housing outlet.

(4) Install the end of the hose in a dry container.

(5) Operate the engine at rated RPM for one (1) minute.

(6) Shut the engine off, and measure the amount of coolant collected in the container.

(7) The amount of coolant collected must not be more than 3.3 fluid ounces (100 cc).

(8) If more than 3.3 fluid ounces (100 cc) of coolant is collected, the thermostat seal is leaking.

(9) Remove the thermostat and inspect as follows:

(a) Visually inspect the thermostat for damage.

(b) Suspend the thermostat and a 212°F (100°C) thermometer in a container of water.
Note: Do not allow the thermostat or the thermometer to touch the sides of the container.

(c) Heat the water.

_1_ Write down the temperatures at which the thermostat begins to open and when it is fully open.

_2_ The nominal operating temperature is stamped on the thermostat.

_3_ The thermostat must begin to open within 2°F (1°C) of nominal temperature.

_4_ The thermostat must be fully open to at least 0.375-inch (9.5 mm) within 22° F (12°C) of nominal temperature.

_5_ Visually inspect the thermostat seal for cracks, corrosion, or other damage; Replace if necessary.

(d) Replace the thermostat if it does not operate as described.

k. Check if water pump is malfunctioning; replace the water pump.

l. Check for obstructed or damaged aftercooler; replace aftercooler.

4. Conduct troubleshooting procedures for loss of engine coolant (overflow).

a. Check if cooling system is overfilled; drain coolant to proper level.

b. Check for dirt, scale, or sludge in the cooling system; clean cooling system.

c. Check for frozen coolant due to incorrect antifreeze concentration; check coolant antifreeze concentration.

d. Check if engine is overheating.

e. Check for defective cylinder head, head gasket, cylinder block, or liner as follows:

(1) Drain the engine lubricating oil.

(2) Remove the lubricating oil pan.

(3) Use 20 psi (140 kPa) air pressure to pressurize the engine cooling system.

Note: Apply the air pressure 15 minutes before inspecting the cylinder liner, the crevice seal, or the cylinder block for coolant leaks.

(4) Inspect the inside and the outside diameters of the cylinder liners and also the area of the cylinder block around the crevice seals and the push tube cavity for coolant leaks.

(5) If a leak is found, remove the pressure test equipment. Remove the cylinder head and gasket and inspect for coolant leaks.

(6) Replace the cylinder head or gasket as required

(7) Remove and inspect the cylinder liner(s) for cracks, porosity, or crevice seal damage.

(8) Remove and inspect the cylinder block (2) for cracks or porosity in the crevice seal area.

(9) Install a new gasket and the lubricating oil pan.

(10) Fill the engine with clean lubricating oil.

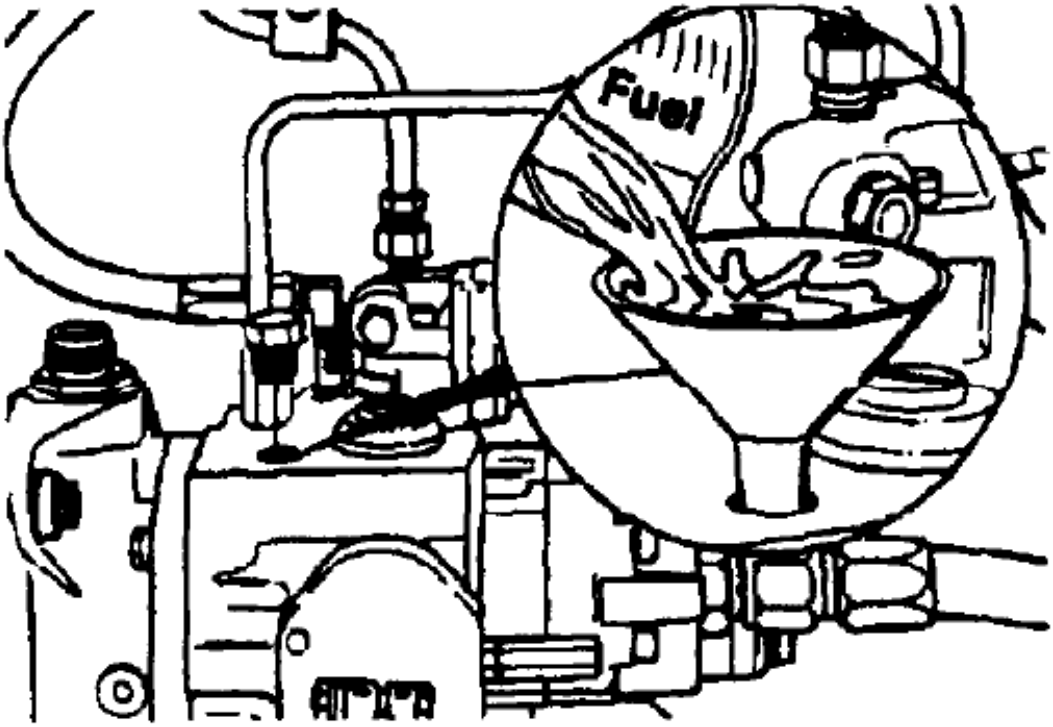
Note:
Make sure the oil drain plug is tight.

(11) Operate the engine until it reaches a temperature of 180°F (80°C), and check for coolant or lubricating oil leaks

5. Conduct troubleshooting for loss of fuel prime.

Note: Loosen the fuel line at the solenoid shutoff valve while the engine is cranking. Ifthe fuel does not come out of the connection, the pump must be primed.
If fuel pump is dirty, clean the outside of the pump.

a. Remove the priming plug Figure 551-88L-3064_02 from the top of the housing.



Priming Plug
Figure 551-88L-3064_02

b. Fill the housing with clean fuel oil.

c. Tighten the plug to 20 ft-lb (30 N•m) torque.

d. If the priming plug is hard to remove, remove the fuel supply hose to the gear pump.

e. Fill the gear pump with clean engine lubricating oil.

f. If fuel does not come out of the connection now, replace the pump.

g. Install the supply hose to the gear pump.

(Asterisks indicates a leader performance step.)

Evaluation Guidance: None

Evaluation Preparation: None

PERFORMANCE MEASURES	GO	NO-GO	N/A
1. Demonstrated basic troubleshooting procedures for a generator.			
a. General Engine Noise			
b. Frequency of Engine Noise.			
c. Isolating Engine Noise.			
d. Accessory Noise.			
e. Main Bearing Noise.			
f. Connecting Rod Bearing Noise.			
g. Piston Noise.			
h. White Smoke.			
2. Conducted basic troubleshooting procedures for a generator.			
a. Loss of engine coolant (external leakage).			
b. Loss of engine coolant (internal leakage).			
c. Low lubricating oil pressure.			
d. High lubricating oil pressure.			
e. Lubricating oil temperature above normal.			
f. Excessive lubricating oil consumption.			
g. Turbocharger noise.			
h. Low power or excessive smoke (low turbocharger boost pressure).			
3. Conducted troubleshooting procedure for coolant temperature above normal.			
4. Conducted troubleshooting procedures for loss of engine coolant (overflow).			
5. Conducted troubleshooting for loss of fuel prime.			

Supporting Reference(s):

Step Number	Reference ID	Reference Name	Required	Primary
	TM 55-1905-223-24-3	UNIT, INTERMEDIATE DIRECT SUPPORT AND INTERMEDIATE GENERAL SUPPORT MAINTENANCE INSTRUCTION SHIPS SERVICE GENERATOR FOR LANDING CRAFT UTILITY (LCU) (NSN 1905-01-154-1191) (REPRINTED W/BASIC INCL C1-5) (TH	No	No

Environment: Environmental protection is not just the law but the right thing to do. It is a continual process and starts with deliberate planning. Always be alert to ways to protect our environment during training and missions. In doing so, you will contribute to the sustainment of our training resources while protecting people and the environment from harmful effects. Refer to FM 3-34.5 Environmental Considerations and GTA 05-08-002 ENVIRONMENTAL-RELATED RISK ASSESSMENT.

Safety: In a training environment, leaders must perform a risk assessment in accordance with ATP 5-19, Risk Management. Leaders will complete the current Deliberate Risk Assessment Worksheet in accordance with the TRADOC Safety Officer during the planning and completion of each task and sub-task by assessing mission, enemy, terrain and weather, troops and support available-time available and civil considerations, (METT-TC). Note: During MOPP training, leaders must ensure personnel are monitored for potential heat injury. Local policies and procedures must be followed during times of increased heat category in order to avoid heat related injury. Consider the MOPP work/rest cycles and water replacement guidelines IAW FM 3-11.4, Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection, FM 3-11.5, Multiservice Tactics, Techniques, and Procedures for Chemical, Biological, Radiological, and Nuclear Decontamination.

Prerequisite Individual Tasks : None

Supporting Individual Tasks :

Task Number	Title	Proponent	Status

551-88L-1042	Demonstrate Basic Knowledge of a Power Generation System	551 - Transportation (Individual)	Analysis

Supported Individual Tasks :

Task Number	Title	Proponent	Status
551-88L-1042	Demonstrate Basic Knowledge of Power Generation System	551 - Transportation (Individual)	Approved

Supported Collective Tasks : None

ICTL Data :

ICTL Title	Personnel Type	MOS Data
88L30 Watercraft Engineer	Enlisted	MOS: 88L, Skill Level: SL3, Duty Pos: TFR, LIC: EN
88L40 Watercraft Engineer	Enlisted	MOS: 88L, Skill Level: SL4, Duty Pos: TGB, LIC: EN, SQI: O